

- (1) Champion Food Service Inc. is a food distribution company that supplies food and supplies to a mix of restaurants, a lot of them Mexican, and food chains to the San Antonio, Texas region, where it's located. It also supplies food and supplies to greater Texas.

At a high level, there are multiple core components of the business. The business has employees, vehicles, clients, inventory of its supplies and food, driver routes on which the orders are delivered, and who's supplying the food and resources to Champion.

- (2) Employees clock in their hours through Square, a business software. They also get paid by check bi-weekly. Unless asked, employees are not asked for their SSNs and are identified by their names and an employee ID. Only the driver is asked to show their driver's license to qualify. There are two managers: Manager of Goods and Manager of Personnel, and one Director who manages both managers. Employees are paid based on work and don't get paid if they take sick days off. However, those who worked for a year do get 1-2 weeks of paid time off.
- (3) For transportation, there are three categories of trucks. The company has 3 box trucks, 2 box trucks that are broken down, and 1 van. Drivers drive the trucks and the vans and are assigned a vehicle by random. Each of the 8 drivers is paid by hour. Usually, they work 40 hours per week and may earn up to 5-10 hours of overtime. They get paid by the hour and are tracked through a GPS tracking system installed on the trucks. Drivers are more seasonal and temporary, as they come and go all of the time. Drivers are allowed for breaks, determined by themselves and based on an honor system.
- (4) Now, the drivers are assigned to a route determined by the Director or the Manager of the Managers. The manager determines the assigned routes based on order inflow. The routes themselves are created based on efficiency. That means if business A and business B need deliveries at x and y times, the director will determine which business the driver will go to first. The stops depend on the number of orders.
- (5) A restaurant can only become a client by having a business tax ID. Without it, you could be an individual who buys from Champion Food Services Inc. without wholesale pricing benefits. Each business actually has an account with the company that's stored in some tracker. The business would be manually recorded, and their phone numbers and bank account information would be held. If you're an individual, you'd need to come to the business physically to pick up orders and pay in cash only.
- (6) Now, the orders are processed by something called a manifest. The manifest would contain the per unit price and goods in the warehouse. The salesmen would also track who didn't buy what and how much for a variable amount of weeks; this information would help them to advertise sales to their assigned customers.
- (7) If the restaurant calls in before the afternoon, the order will be delivered the same day, as most orders are. However, if the order is requested in the afternoon, it will be delivered the next day. Emergency deliveries would have a case-by-case basis. In total, Champion has an MAU of 300 and a total customers of 700. The secretaries in the office would then tape the manifests to the wall connected to the warehouse.

- (8) Only the manager knows the quantity of goods in the warehouse, as there's no tracking system available. The salesmen would ask if there are items requested by the client in stock to the Director or the Goods manager. If it's easily procurable, the Director would order something from Sam's Clubs, and later in the day, a driver would go pick it up. Usually, orders are done by suppliers who alert the Director of incoming price increases or goods that they just need. Champion Food Services has the following distributors: Cargill, Excel Fresh Meats, Swift, and Sukarne as their meat suppliers.
- (9) The Director would give a call to suppliers and the goods would be delivered at a date. They would come in trucks. These delivered goods would be unloaded from the distributor's trucks. There's only 1 worker in the warehouse who unloads each cargo into the warehouse. The location of where a certain good belongs is only known by the Director or the Manager of Goods.
- (10) To actually get the goods in the warehouse to the departing trucks for deliveries to customers, the pallet jacks are parked on the perimeter of the warehouse based on manifests tapped out the window. Like a restaurant, each manifest is handled and the items in the order are loaded onto the pallet jacks ready to be loaded onto the trucks for delivery.
- (11) Managers or the Director check each order to ensure that the right goods are loaded onto the pallets. To load the pallets, only the Managers of the warehouse are allowed to load it onto the vans or trucks undocking at the warehouse gates. The warehouse itself is 11,800 square feet.
- (12) Each box truck has about a capacity of 8 pallets and averages 2 routes per day. There's also a seasonal employee in the office, whose role is to greet returning drivers and process the cash or checks in the envelopes that were received by the drivers as payments from customers. This employee then punches the numbers into Quickbooks to keep track of revenue. When this employee isn't on duty, one of the two other office employees is put in charge of handling this work.
- (13) The manager instructs the salesman what restaurants to go to for new sales, and each salesman, the 3 of them, are assigned to some specific restaurant to serve as a point of communicator to the warehouse. The salesman gets calls from restaurants about orders each day, and if an item is unavailable, it goes to the backorder.
- (14) The order that the salesman takes is then messaged to the office, where there are two secretaries. One secretary punches in the orders. The other secretary focuses on returns. If a customer determines that the goods aren't in satisfactory condition, the goods will be returned for future purchasing credits like a mixed-up order. If the goods were exceptionally spoiled or the customer was overcharged, the customer would be refunded cash. There's also an Account Manager who works virtually in charge of doing the taxes.
- (15) There are high demand products like eggs- of which they sell 200-500 cases per week. These high demand products are sold quickly, so the chances of them spoiling is very low. There are also other highly in demand goods like sodas, including Mexican Coca-Cola, Jarritos, Mexican Sprite, and Dr. Pepper. Their most popular products are ground beef, cheek meat: cow/barbacoa, bacon, tortilla flour, and tomatillo (Green Tomatoes).

- (16) The company also has a specific processing and handling for frozen meats. Champion has two butchers. One man and one woman. The woman is also the janitor. Only on Saturdays, the man butcher drives the truck. The business is open from 6 am to 5 pm on weekdays, and 7 am to 10 am on Saturdays. On Sundays, Champion is closed.
- (17) The most popular meats are cow, pig, chicken, fish, and tilapia. There are also processed chicken nuggets. However, the butcher is told by the Director what cuts of meat to make based on customer requests (as there are no manifests for the butcher), and the butchers make those cuts. Usually, the butcher just cuts the meat up and packs them into a box to distribute to the restaurants. The butcher works in a meat shop and all of the meats are placed into an isolated freezer box in the warehouse.
- (18) In particular to a specific customer- the taco trucks, the company delivers to the taco trucks based on their fixed parking location. If a taco truck is known to be parked overnight at the parking lot of a Jiffylube, Champion would deliver to the taco truck at that location. Champion ensures that taco trucks' deliveries are met before their day starts.
- (19) Every morning, there's a meeting where the salesman and employees are told by the Director what to do.
- (20) To fix the broken trucks in the yard, the mechanic has his own shop behind the warehouse, in a field to work on the trucks. When the trucks are finished, they go back into service. The mechanic orders parts from Amazon or fetches the materials by himself. He does not drive the company's trucks. The mechanic also fixes the workers' cars. His charge is invoiced to the company, which then asks the company employee to pay to the order of the company. The mechanic is an exception, where he is salaried on a yearly basis. The charge he invoices the company is based on the cost of the parts and the number of hours worked.
- (21) To refuel the trucks, at the end of each day, a random driver is assigned to put gas into the trucks for the next day at a nearby gas station. That cost is tabulated and paid by the company.

## ***8-step algorithm***

### **Step 1: Strong Entity Sets**

Client(ClientID, AccountStatus, PaymentType, LastOrderDate)

People(ClientID, ClientFirstName, ClientLastName, Phone#)

Business(ClientID, TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName)

Account(Account#, CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate)

Order(OrderID, OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus)

Route(RouteID, RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus)

Employee(EmployeeID, FirstName, LastName, HireDate, WeeklyHours, HourlyRate, PartTimeOffBalance)

Vehicle(LicensePlate#, VehicleType, LastMaintenanceDate, OperationStatus, Capacity, InsurancePolicy#, PurchaseDate)

Paycheck(PaycheckID, PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions)

Inventory(ItemID, ItemName, CategoryType, MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice)

Supplier(SupplierID, CompanyName, CompanyPerson, ContactInfo, ActiveStatus, ProductCategories, PreferredDeliveryDays, PaymentTerm)

## Step 2: Weak Entity Sets

Maintenance(LicensePlate#, ServiceDate, Description, Cost, PartsUsed, LaborHours, MaintenanceType)

**[Became a weak entity set]**

StockChange(ItemID, StockChangeDate, QuantityChange, Reason) **[New Table]**

CustomMeatOrder(CustomOrder#, OrderID, MeatType, CutSpecifications, Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck)

OrderItem(OrderItemID, OrderID, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus)

## Step 3: 1-1:

Every account has a client involved: The account gets ClientID as F.K.

Updated Account Relation:

Account(Account#, CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate, ClientID)

## Step 4: 1-M:

- (1) OrderItem to Order: OrderItem obtains the OrderID as part of its primary key, already considered
- (2) Order to Client: Order has the many, will retrieve the ClientID from Client
- (3) Order to Employee: Order has the many, will retrieve the EmployeeID from Employee
- (4) Order to Route: Order has the many, will capture the RouteID from Route
- (5) Route to Vehicle: Route has the many, will capture the LicensePlate# from Vehicle
- (6) Maintenance to Vehicle: Maintenance obtains the LicensePlate# as part of its primary key, already considered
- (7) CustomMeatOrder to Order: CustomMeatOrder has the many, already captured OrderID when building the set
- (8) Paycheck to Employee: Paycheck has the many, will capture the EmployeeID from Employee
- (9) Maintenance to Employee: Maintenance has the many, will capture the EmployeeID from Employee
- (10) CustomMeatOrder to Employee: CustomMeatOrder has the many, will capture the EmployeeID from Employee
- (11) OrderItem to Inventory: OrderItem has the many, will capture the ItemID from Inventory
- (12) Employee to Route: Route has the many, will capture EmployeeID from Employee
- (13) StockChange to Inventory: StockChange retrieves the ItemID as part of its primary key, already considered
- (14) StockChange to Client: StockChange retrieves the ClientID from the Client

## Here are the finalized relations for this step:

OrderItem(OrderItemID, OrderID, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID)

Order(OrderID, OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus, ClientID, EmployeeID, RouteID)

Route(RouteID, RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus, LicensePlate#, EmployeeID)

Maintenance(LicensePlate#, ServiceDate, Description, Cost, PartsUsed, LaborHours, MaintenanceType, EmployeeID)

CustomMeatOrder(CustomOrder#, OrderID, MeatType, CutSpecifications, Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID)

Paycheck(PaycheckID, PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID)

StockChange(ItemID, StockChangeDate, QuantityChange, Reason, ClientID)

### Step 5: M-N Relationships [Added]

Inventory to Supplier: Since both the Supplier and Inventory have many, a new table will be created that includes the supplier ID from the Supplier and item ID from the Inventory table.

SupplierItem(SupplierID, ItemID)

### Step 6: Multi-value Attributes

Role in Employee:

Role(Role, EmployeeID)

### Step 8:

Disjoint:

Client, People, and Business relations will stay and have the following relational schema:

Client(ClientID, AccountStatus, PaymentType, LastOrderDate)

People(ClientID, ClientFirstName, ClientLastName, Phone#)

Business(ClientID, TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName)

### Here are the final relational schemas from the diagram:

- 1) Client(ClientID, AccountStatus, PaymentType, LastOrderDate)
- 2) People(ClientID, ClientFirstName, ClientLastName, Phone#)
- 3) Business(ClientID, TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName)
- 4) OrderItem(OrderItemID, OrderID, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID)
- 5) Supplier(SupplierID, CompanyName, CompanyPerson, ContactInfo, ActiveStatus, ProductCategories, PreferredDeliveryDays, PaymentTerm)
- 6) Order(OrderID, OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus, ClientID, EmployeeID, RouteID)
- 7) Route(RouteID, RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus, LicensePlate#, EmployeeID)
- 8) Maintenance(LicensePlate#, ServiceDate, Description, Cost, PartsUsed, LaborHours, MaintenanceType, EmployeeID)
- 9) CustomMeatOrder(CustomOrder#, OrderID, MeatType, CutSpecifications, Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID)

- 10) Paycheck(PaycheckID, PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID)
- 11) Account(Account#, CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate, ClientID)
- 12) Employee(EmployeeID, FirstName, LastName, HireDate, WeeklyHours, HourlyRate, PartTimeOffBalance)
- 13) Inventory(ItemID, ItemName, CategoryType, MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice)
- 14) Vehicle(LicensePlate#, VehicleType, LastMaintenanceDate, OperationStatus, Capacity, InsurancePolicy#, PurchaseDate)
- 15) Role(Role, EmployeeID)
- 16) SupplierItem(SupplierID, ItemID) **[New Table]**
- 17) StockChange(ItemID, StockChangeDate, QuantityChange, Reason, ClientID) **[Renamed from StockMovement]**

**Functional dependencies:**

Functional Dependencies	Count	Dependency Justifications
EmployeeID→FirstName,LastName,HourlyRate,PartTimeOffBalance	1	“Employees clock in their hours through Square, a business software. They also get paid by check bi-weekly”, “Employees are not asked for their SSNs and are identified by their names and an employeeID”, “Employees are paid based on work and don’t get paid if they take sick days off. However, those who worked for a year do get 1-2 weeks of paid time off.”
EmployeeID→WeeklyHours	2	“Each of the 8 drivers is paid by hour. Usually, they work 40 hours per week and may earn up to 5-10 hours of overtime”, “The mechanic is an exception, where he is salaried on a yearly basis”
LicensePlate#→VehicleType,Capacity,OperationStatus	3	“For transportation, there are three categories of trucks. The company has 3 box trucks, 2 box trucks that are broken down, and 1 van.”, “Each box truck has about a capacity of 8 pallets and averages 2 routes per day”
ClientID→BusinessName,BusinessType,ContactFirstName, ContactLastName,AccountStatus	4	“A restaurant can only become a client by having a business tax ID”, “Each business actually has an account with the company that’s stored in some tracker”
TaxID→BusinessName	5	“A restaurant can only become a client by having a business tax ID”
OrderID→ClientID, OrderDate, DeliveryDate, OrderVehicleStatus	6	“The order that the salesman takes is then messaged to the office, where there are two secretaries. One secretary punches in the orders”, “If the restaurant calls in before the afternoon, the order will be delivered the same day, as most orders are. However, if the

		order is requested in the afternoon, it will be delivered the next day.”
RouteID → EmployeeID, LicensePlate#, RouteDate, RouteVehicleStatus	7	“Drivers drive the trucks and the vans and are assigned a vehicle by random”, “The routes themselves are created based on efficiency”, “Now, the drivers are assigned to a route determined by the Director or the Manager of the Managers”
OrderID, OrderItemID → TotalAmount, WholeSalePrice, RetailPrice	8	“Now, the orders are processed by something called a manifest. The manifest would contain the per unit price and goods in the warehouse”, “The salesmen would also track who didn’t buy what and how much for a variable amount of weeks”
EmployeeID → PayType	9	“Employees are paid based on work and don’t get paid if they take sick days off.”
TaxID → BusinessName, Address, BusinessType, ContactFirstName, ContactLastName	10	“A restaurant can only become a client by having a business tax ID.”
ClientID → Account#	11	“Each business actually has an account with the company that’s stored in some tracker”
LicensePlate#, ServiceDate → EmployeeID, Description, Cost, PartsUsed, LaborHours, MaintenanceType	12	“To fix the broken trucks in the yard, the mechanic has his own shop behind the warehouse, in a field to work on the trucks. When the trucks are finished, they go back into service. The mechanic orders parts from Amazon or fetches the materials by himself... The charge he invoices the company is based on the cost of the parts and the number of hours worked.”
<b>EER Diagram</b>		
ClientID → AccountStatus, PaymentType, LastOrderDate	13	Client( <u>ClientID</u> , AccountStatus, PaymentType, LastOrderDate)
ClientID→ClientFirstName, ClientLastName,Phone#	14	People( <u>ClientID</u> , ClientFirstName, ClientLastName, Phone#)
ClientID → TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName	15	Business( <u>ClientID</u> , TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName)
OrderItemID, OrderID → OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID	16	OrderItem( <u>OrderItemID</u> , <u>OrderID</u> , OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID)
SupplierID→CompanyName, CompanyPerson,ContactInfo, ActiveStatus,ProductCategories, PreferredDeliveryDays, PaymentTerm	17	Supplier( <u>SupplierID</u> , CompanyName, CompanyPerson, ContactInfo, ActiveStatus, ProductCategories, PreferredDeliveryDays, PaymentTerm)

OrderID → OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus, ClientID, EmployeeID, RouteID	18	Order( <u>OrderID</u> , OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus, ClientID, EmployeeID, RouteID)
RouteID → RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus, LicensePlate#, EmployeeID	19	Route( <u>RouteID</u> , RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus, LicensePlate#, EmployeeID)
LicensePlate#, ServiceDate → Description, Cost, PartsUsed, LaborHours, MaintenanceType, EmployeeID	20	Maintenance( <u>LicensePlate#</u> , <u>ServiceDate</u> , Description, Cost, PartsUsed, LaborHours, MaintenanceType, EmployeeID)
CustomOrder#,OrderID→MeatType,CutSpecifications,Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID	21	CustomMeatOrder( <u>CustomOrder#</u> , <u>OrderID</u> ,MeatType,CutSpecifications,Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID)
PaycheckID → PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID	22	Paycheck( <u>PaycheckID</u> , PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID)
Account#→CurrentBalance,PaymentTerm,CreditLimit,AccountStatus,LastPaymentAmount, LastPaymentDate, ClientID	23	Account( <u>Account#</u> , CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate, ClientID)
EmployeeID→FirstName,LastName,HireDate,WeeklyHours,HourlyRate, PartTimeOffBalance	24	Employee( <u>EmployeeID</u> ,FirstName,LastName,HireDate,WeeklyHours,HourlyRate, PartTimeOffBalance)
ItemID→ItemName,CategoryType,MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice	25	Inventory( <u>ItemID</u> , ItemName, CategoryType, MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice)
LicensePlate#→VehicleType,LastMaintenanceDate, OperationStatus,Capacity,InsurancePolicy#, PurchaseDate	26	Vehicle( <u>LicensePlate#</u> ,VehicleType,LastMaintenanceDate,OperationStatus,Capacity,InsurancePolicy#, PurchaseDate)
Role, EmployeeID → other attributes	27	Role( <u>Role</u> , <u>EmployeeID</u> )
SupplierID, ItemID → other attributes	28	SupplierItem( <u>SupplierID</u> , <u>ItemID</u> )
ItemID, StockChangeDate → QuantityChange, Reason, ClientID	29	StockChange( <u>ItemID</u> , <u>StockChangeDate</u> , QuantityChange, Reason, ClientID)



### ***Normalization to 3NF:***

Here is the process for converting our relations into 3NF form:

#### **Step 1: Finding the Canonical Cover of F:**

To find the canonical cover of F, we need to first unionize any Left-Hand Side similarities to simplify the list of dependencies.

1, 2, 9 and 24 all have EmployeeID as their main attribute on the left-hand side, these will be unionized together to get the following new functional dependency:

- 1) EmployeeID→FirstName,LastName,HourlyRate, PartTimeOffBalance
- 2) EmployeeID→WeeklyHours
- 9) EmployeeID → PayType
- 24) EmployeeID→FirstName,LastName,HireDate,WeeklyHours,HourlyRate, PartTimeOffBalance

**EmployeeID → FirstName, LastName, HireDate, WeeklyHours, HourlyRate, PartTimeOffBalance**

3 and 26 have the same LicensePlate# attribute on the left-hand side, these will unionize to give you the following new functional dependency:

- 3) LicensePlate#→VehicleType,Capacity,OperationStatus
- 26) LicensePlate#→VehicleType,LastMaintenanceDate, OperationStatus,Capacity,InsurancePolicy#, PurchaseDate

**LicensePlate# → VehicleType, LastMaintenanceDate, OperationStatus, Capacity, InsurancePolicy#, PurchaseDate**

4, 11, 13, 14 and 15 have ClientID as their left-hand side attribute, all of them will be unionized to give you the following new functional dependency:

- 4) ClientID→BusinessName,BusinessType,ContactFirstName, ContactLastName,AccountStatus
- 11) ClientID → Account#
- 13) ClientID → AccountStatus, PaymentType, LastOrderDate
- 14) ClientID→ClientFirstName, ClientLastName,Phone#
- 15) ClientID → TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName

Everything Combined:

**ClientID → BusinessName, BusinessType, ContactFirstName, ContactLastName, AccountStatus, Account#, PaymentType, LastOrderDate, ClientFirstName, ClientLastName, Phone#, TaxID, Address**

6 and 18 will be combined with the same attribute OrderID, this will be the new resulting functional dependency:

- 6) OrderID → ClientID, OrderDate, DeliveryDate, OrderVehicleStatus
- 18) OrderID → OrderDate, DeliveryDate, OrderStatus, TotalAmount, PaymentStatus, ClientID, EmployeeID, RouteID

Everything Combined:

**OrderID → ClientID, OrderDate, DeliveryDate, OrderVehicleStatus, OrderStatus, TotalAmount, PaymentStatus, EmployeeID, RouteID**

7 and 19 also have RouteID as the attributes found in the Left-Hand-Side, these will be combined as follows:

- 7) RouteID → EmployeeID, LicensePlate#, RouteDate, RouteVehicleStatus
- 19) RouteID → RouteDate, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus, LicensePlate#, EmployeeID

Everything Combined:

**RouteID → EmployeeID, LicensePlate#, RouteDate, RouteVehicleStatus, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus**

8 and 16 have both OrderID and OrderItemID as their left-hand-side attributes, which will result in the following functional dependency:

- 8) OrderID, OrderItemID → TotalAmount, WholeSalePrice, RetailPrice
- 16) OrderItemID, OrderID → OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID

Everything Combined:

**OrderID, OrderItemID → TotalAmount, WholeSalePrice, RetailPrice, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID**

12 and 20 have LicensePlate#, ServiceDate as the common attributes on the Left-Hand-Side. These F.D's will be combined as followed:

- 12) LicensePlate#, ServiceDate → EmployeeID, Description, Cost, PartsUsed, LaborHours, MaintenanceType
- 20) LicensePlate#, ServiceDate → Description, Cost, PartsUsed, LaborHours, MaintenanceType, EmployeeID

Everything Combined:

**LicensePlate#, ServiceDate → EmployeeID, Description, Cost, PartsUsed, LaborHours, MaintenanceType**

5 and 10 have TaxID as the common attribute found on the Left-Hand-Side, these will be combined as followed: **[More F.D's to Unionize]**

- 5) TaxID→BusinessName
- 10)TaxID → BusinessName, Address, BusinessType, ContactFirstName, ContactLastName

Everything Combined:

**TaxID → BusinessName, Address, BusinessType, ContactFirstName, ContactLastName**

Everything appears to have been unionized, this is now our current updated list of functional dependencies:

1. **EmployeeID → FirstName, LastName, HireDate, WeeklyHours, HourlyRate, PartTimeOffBalance**
2. **LicensePlate# → VehicleType, LastMaintenanceDate, OperationStatus, Capacity, InsurancePolicy#, PurchaseDate**
3. **ClientID → BusinessName, BusinessType, ContactFirstName, ContactLastName, AccountStatus, Account#, PaymentType, LastOrderDate, ClientFirstName, ClientLastName, Phone#, TaxID, Address**
4. **OrderID → ClientID, OrderDate, DeliveryDate, OrderVehicleStatus, OrderStatus, TotalAmount, PaymentStatus, EmployeeID, RouteID**
5. **RouteID → EmployeeID, LicensePlate#, RouteDate, RouteVehicleStatus, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus**
6. **TaxID → BusinessName, Address, BusinessType, ContactFirstName, ContactLastName**
7. **OrderID, OrderItemID → TotalAmount, WholeSalePrice, RetailPrice, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID**
8. **LicensePlate#, ServiceDate → EmployeeID, Description, Cost, PartsUsed, LaborHours, MaintenanceType**
9. **SupplierID→CompanyName,CompanyPerson,ContactInfo, ActiveStatus,ProductCategories, PreferredDeliveryDays, PaymentTerm**
10. **CustomOrder#, OrderID → MeatType, CutSpecifications, Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID**

11. **PaycheckID** → **PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID**
12. **Account#** → **CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate, ClientID**
13. **ItemID** → **ItemName, CategoryType, MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice**
14. **ItemID, StockChangeDate** → **QuantityChange, Reason, ClientID**

From what it appears currently, there are no extraneous attributes that can be removed that can be made to this current list of functional dependencies. Therefore, the 15 dependencies above can move on to the 3NF decomposition phase.

Each dependency within the cover, will be converted into its relational schema, here are the following relations:

- (Employee)** R1 = (EmployeeID, FirstName, LastName, HireDate, WeeklyHours, HourlyRate, PartTimeOffBalance)
- (Vehicle)** R2 = (LicensePlate#, VehicleType, LastMaintenanceDate, OperationStatus, Capacity, InsurancePolicy#, PurchaseDate)
- (Client)** R3 = (ClientID, BusinessName, BusinessType, ContactFirstName, ContactLastName, AccountStatus, ClientFirstName, ClientLastName, Account#, PaymentType, LastOrderDate, Phone#, TaxID, Address)
- (OrderTable)** R4 = (OrderID, ClientID, OrderDate, DeliveryDate, OrderVehicleStatus, OrderStatus, TotalAmount, PaymentStatus, EmployeeID, RouteID)
- (Route)** R5 = (RouteID, EmployeeID, LicensePlate#, RouteDate, RouteVehicleStatus, StartTime, EndTime, TotalStops, EstimatedMileage, RouteStatus)
- (Business)** R6 = (TaxID, BusinessName, Address, BusinessType, ContactFirstName, ContactLastName)
- (OrderItem)** R7 = (OrderID, OrderItemID, TotalAmount, WholeSalePrice, RetailPrice, OrderStatus, DeliveryDate, OrderDate, TotalAmount, PaymentStatus, ItemID)
- (Maintenance)** R8 = (LicensePlate#, ServiceDate, EmployeeID, Description, Cost, PartsUsed, LaborHours, MaintenanceType)
- (Supplier)** R9 = (SupplierID, CompanyName, CompanyPerson, ContactInfo, ActiveStatus, ProductCategories, PreferredDeliveryDays, PaymentTerm)
- (CustomerOrder)** R10 = (CustomOrder#, OrderID, MeatType, CutSpecifications, Weight, ProcessingInstructions, ProcessingDate, CompletionStatus, QualityCheck, EmployeeID)
- (Paycheck)** R11 = (PaycheckID, PaymentDate, NetPay, PayPeriodStart, PayPeriodEnd, PaymentMethod, RegularHours, OvertimeHours, GrossPay, Deductions, EmployeeID)
- (Account)** R12 = (Account#, CurrentBalance, PaymentTerm, CreditLimit, AccountStatus, LastPaymentAmount, LastPaymentDate, ClientID)
- (Item)** R13 = (ItemID, ItemName, CategoryType, MinimumStock, WholesalePrice, StorageType, RetailPrice, PerUnitPrice)
- (StockChange)** R14 = (ItemID, StockChangeDate, QuantityChange, Reason, ClientID)
- (EmployeeRole)** R15 = (Role, EmployeeID)
- (SupplierItem)** R16 = (SupplierID, ItemID)

All attributes have been included at most in one of these relations, and each relation has a candidate key within its relation. Thus, this is the final 3NF decomposition of our relations.